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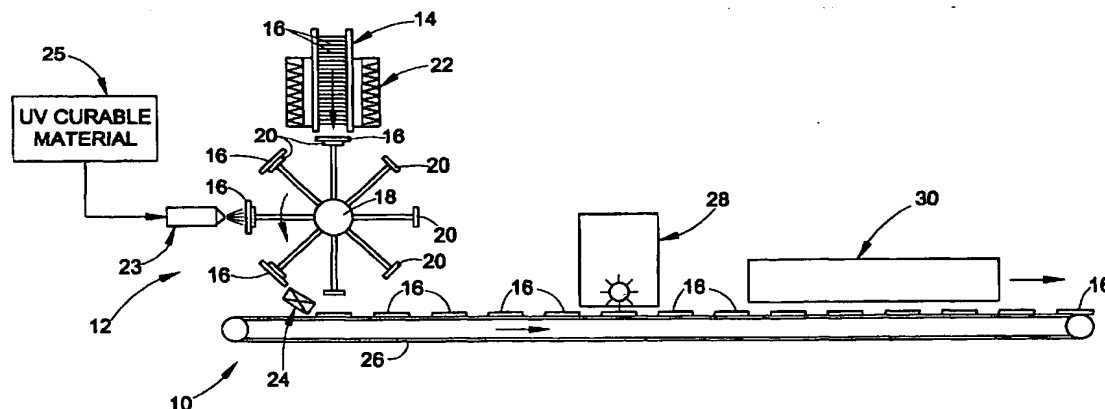
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(54) Title: CAN LID SCORE REPAIR WITH UV CURABLE MATERIAL



(57) Abstract: Apparatus and methods for applying material to a surface are provided using ultraviolet (UV) curable material. The use of the material is especially applicable to repairing score lines for can lids. The process and apparatus may optionally include the use of preheat and post-heat operations following application of the material to the can lid. Application may be by spraying and the heating may be by induction heating.

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**CAN LID SCORE REPAIR WITH UV CURABLE MATERIAL****Related Application**

This application claims the benefit of United States Provisional patent application serial no. 60/421,663 filed on October 28, 2002 for UV INDUCTION PRE-HEAT AND POST CURE  
5 FOR POST SCORE REPAIR SPRAY OF CAN ENDS, the entire disclosure of which is fully incorporated herein by reference.

**Technical Field Of The Invention**

The invention relates generally to apparatus and methods for applying material onto a surface. More particularly, the invention relates to applying material to a surface with the  
10 material being of the type that can cure quickly.

**Background of the Invention**

Containers such as beverage containers often include a lid having what is commonly known as an "easy open" or "pop top" lid. Such lids typically include a tab that is manually pivoted by the consumer so as to cause a frangible portion of the lid to separate from and bend  
15 away the main lid body, thereby providing an opening to access the contents such as by drinking or pouring.

In order to facilitate the opening of the lid, the lids are manufactured with a score line. The score line is characterized by a thinned portion of the lid wall which makes it easier to open the container under force of the tab. The score line typically extends around all or part of the lid,  
20 and a small portion also typically extends under the tab.

Container lids, especially those that are used to hold ingestible products, are usually first coated with a suitable material such as tin plating. This coating becomes scratched or otherwise damaged or removed during the scoring process, especially in the area of the score line itself. It is known to repair the score line portion of the lid, for example, by applying a two part epoxy  
25 coating. The primary purpose of the re-coat is to prevent corrosion.

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Score line repair with a two part coating is a very expensive and inefficient process. Large ovens, long conveyors and long dwell times are needed to adequately cure the coating. The ovens typically are quite large, often times vertically arranged because the can lids must traverse through them for adequate cure times. The ovens typically use costly gas heat. And  
5 some coatings may require 10-15 minute cure times or longer. This significantly slows down throughput or results in very large ovens and conveyors, requiring a substantial area of manufacturing space.

The need exists therefore to provide process and apparatus for applying coating material to a surface such as a scored can lid that overcomes or diminishes the aforementioned limitations  
10 of known systems.

### **Summary Of The Invention**

The invention contemplates in one aspect use of an ultraviolet (UV) curable material applied to a surface. In one embodiment, a UV curable material is applied to a can lid,  
15 in particular a score line. The UV curable material is used to repair damage to the lid coatings that can occur as a result of the scoring process. The UV curable material is used in lieu of conventional two part epoxy materials. The UV curable material is at least partially or completely cured by exposing the material to UV energy. A preferred although not required aspect of the material is that it cure in response to heat application as well as UV energy.

20 In accordance with additional aspects of the invention, application of the UV curable material to a surface is facilitated by an optional preheat step. The can lid is preheated such as by use of an induction or other suitable heating mechanism. In one embodiment, the preheat operation is performed by an induction heater that surrounds a stacker device. The lids are heated as they pass through the stacker to a holder used to present the workpieces to a material  
25 application device such as a spray gun. The preheating step is performed before application of the UV curable material to the surface. Alternatively, the preheating may occur coincident with

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the application of the material to the surface. Uniform application may also be enhanced by imparting relative rotation between the can lid and the application device. A suitable application device may be, for example, an airless spray gun. In some applications, an optional second heating step may be performed after exposing the material to UV energy. The second heating step may be by use of induction heating or other suitable heating mechanism.

These and other aspects and advantages of the present invention will be readily appreciated and understood from the following detailed description of the invention in view of the accompanying drawings.

### **Brief Description Of The Drawings**

Fig. 1 is a schematic representation of a material application system that incorporates the invention; and

Fig. 2 is an exemplary heater in longitudinal cross-section suitable for use in the system of Fig. 1.

### **Detailed Description Of The Invention**

#### **1. INTRODUCTION**

The present invention is directed to apparatus and methods for application of UV curable material onto a surface or workpiece, such as a can lid. Although the invention is described herein with particular reference to applying a UV curable material to repair a score line on a can lid, such description is intended to be exemplary in nature and should not be construed in a limiting sense. Those skilled in the art will readily appreciate that the invention will find use in many other applications for different types of surfaces and workpieces, including but not limited to containers, lids and so on.

Additionally, various aspects of the invention are described and illustrated herein as embodied in the exemplary embodiments. These various aspects however may be realized in

alternative embodiments, either alone or in various combinations and sub-combinations thereof. Still further, various alternative embodiments as to the various aspects and features of the invention, such as alternative materials, structures, methods, devices and so on may be described herein, but such descriptions are not intended to be a complete or exhaustive list of available  
5 alternative embodiments, whether known or later developed. Those skilled in the art may readily adopt one or more of the aspects of the invention into additional embodiments within the scope of the present invention even if such embodiments are not expressly disclosed herein. Additionally, even though some features and aspects of the invention may be described herein as being a preferred arrangement or method, such description is not intended to suggest that such  
10 feature is required or necessary unless so expressly stated. Still further, exemplary or representative values and ranges may be included to assist in understanding the present invention however, such values and ranges are not to be construed in a limiting sense and are only intended to be critical values if so expressly stated.

## **2. DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION**

15 With reference to Fig. 1, a material application system 10 in accordance with an exemplary embodiment of the invention is illustrated in a simplified schematic form. Most of the equipment and individual components illustrated are commercially available and well known to those skilled in the art, therefore, a schematic illustration is sufficient for one of ordinary skill in the art to understand and practice the invention.

20 The system 10 includes an indexing spray machine 12. The indexing spray machine includes a stacker 14 in which a plurality of workpieces 16 may be placed. A rotatable turret 18 includes a plurality of workpiece holding chucks 20. The chucks 20 are each used to individually grab a workpiece as it rotates past the stacker 14. The workpieces may be held against the chuck by suction for example. Alternatively, a magnetic chuck may be used or other suitable technique.

25 Surrounding the stacker 14 or a portion thereof is a first heater 22 illustrated and described in greater detail herein with reference to Fig. 2. The heater 22 is optional and is used

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to improve flow of a material onto the workpieces, as will be described. The heater 22 is used to preheat the workpieces before the UV curable material is applied thereto. In the exemplary embodiment the heater 22 is realized in the form of an induction heater that uses magnetic energy to heat the workpiece. Other heater devices may be used, and alternatively a heater may be used that heats the material 25 and/or the workpiece 16 as the material is applied. In another alternative the material 25 may be heated as part of the application device 23 and/or the source container for the material 25.

The workpieces are presented to a material application device 23 that is in fluid communication with a source of UV curable material 25. The material 25 is preferably but not necessarily, a material that is typically in a liquid state when applied to the workpiece. The material 25 cures or hardens when exposed to UV energy. Preferably although not necessarily it is preferred that the material be also curable by application of heat. In the illustrated example, then the application device 23 is a liquid spray gun. Preferably, although not necessarily, the spray gun is airless so as to reduce or minimize overspray. UV curable materials tend to be rather expensive so it is desirable to apply as little material as needed to properly coat the workpiece. A suitable spray gun is a model MEG II, part no. 344003 available from Nordson Corporation, Westlake, Ohio. Such a spray gun has a very small spray orifice that permits very small amounts of the material 25 to be directed onto the workpiece. Typical amounts dispensed may be on the order of about 5-20 mg or less, however, this range is only exemplary is not intended to be construed in a limiting sense. Proper control of the applied quantity of material not only produces a cost savings but also can reduce frilling or hairing which can occur when excess material is applied. Frilling is an effect whereby too much material produces jagged particles around the edge of a score line when the can lid is opened.

In the exemplary embodiment, the chucks 20 are also used optionally to spin the workpieces at a fairly high rate of speed, such as for example but not by way of limitation, about 1000-1500 rpm. Alternatively, the spray application device 23 may be mounted in a suitable

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mechanism that rotates the spray gun relative to the workpiece. A suitable drive mechanism (not shown) may be used to effect such spinning, as is well known to those skilled in the art.

The indexing spray machine 12 further includes an inverter mechanism 24 that flips each workpiece onto a conventional conveyor 26 so that the sprayed side is up. For example, a  
5 suitable spray indexing machine 12 that is commercially available is model no. 107-LID available from H. L. Fisher Manufacturing Co., Inc. of Des Plains, IL. An alternative system including the control functions associated therewith is described in United States Patent Nos. 5,612,096 and 5,520,735 issued to Mulder et al., the entire disclosures of which are fully incorporated herein by reference. Those skilled in the art will readily appreciate that many  
10 different forms of spray machines and indexing/positioning machines may be used with the present invention.

The conveyor 26 is conventional in design and transports the sprayed workpieces 16 to a UV energy source 28. A suitable UV source or lamp 28 is described in United States Patent No. 6,619,819 issued to Stowell et al., the entire disclosure of which is fully incorporated herein by  
15 reference. The UV lamp 28 may be flashed on as each workpiece is presented thereto by the conveyor 26. Alternatively, the UV lamp can be left on for longer periods or even continuously. The UV coating material will at least partially cure and in most cases nearly completely cure in a short period of time. For example, the material 25 may be exposed to UV energy for about 1 second or less. This short exposure time allows for a high throughput, such as for example 300  
20 workpieces per minute.

After the workpieces are exposed to the UV energy, an optional second heater 30 may be used. The second or post-cure heater 30 is used to again heat the workpieces to complete the cure of the material 25 and depending on the choice of material to improve its adherence to the workpiece. The second heater 30 may be realized in the form of a conventional induction heater  
25 such as model no. ISC-1A available from Nordson Corporation, Westlake, Ohio. The first and second heaters 22, 30 may heat the workpieces to any desired temperature to optimize

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application of the material 25 thereto, such as, for example, about 200 °F. The second heater 30 also helps to ensure cure of the applied material that is under the tab as the tab may prevent full exposure to the UV energy.

With reference to Fig. 2, the first heater 22 which is optionally used to preheat the can lids 26, includes a frame 40 that encloses an induction coil 42. The workpieces may pass through a central passageway 44 in which may be positioned the stacker 14 (*see* Fig. 1). Additional openings 46 may be provided to receive cooling fans (not shown). A more detailed description and understanding of a suitable induction heater suitable for use as the preheat device 22 is provided in United States Patent No. 5,529,703 issued to Sprenger et al., the entire disclosure of which is fully incorporated herein by reference.

A significant advantage of the present invention is that the use of a UV curable material greatly reduces the complexity and size of the material application system. The material can be cured quickly and there is no need for a large oven or long dwell times in order to ensure adequate cure of the material. This greatly increases workpiece throughput volume and substantially reduces the size of the operation within a manufacturing facility.

As noted herein, depending on the type of the UV curable material selected for a particular application, it may be desirable to minimize the quantity of such material that is applied to the workpiece. The preheat device 14 is used to improve the flow of the small quantity of material applied to the workpiece. Flow of the material 25 on the surface of the workpiece is also facilitated by spinning the workpiece as described hereinabove. This is particularly useful when applying UV curable material to repair a scored can lid, because typically the score line extends under the manual tab. Simple spraying might cause the obstructed portion of the score line to be missed. By spinning the workpiece as well as the optional preheat step, the UV curable material flows more evenly and completely to cover the score line even under the tab.



The present invention contemplates the methods embodied in the use of the aforementioned apparatus. Moreover, the invention contemplates a method for repairing a score line by applying a UV curable material thereto and exposing the applied material to a source of UV energy. This method may include optional steps of spinning the workpiece while applying  
5 the material thereto, preheating the workpiece prior to or coincident with applying the material thereto, and heating the workpiece after the material has been at least partially cured by exposure to UV energy. Still further options of the exemplary method include applying the material by spraying, such as with an airless spray gun, and heating the workpieces with induction heating. The invention also contemplates the method of applying a UV curable material to a workpiece  
10 surface by first preheating the workpiece, then applying the material to the workpiece and then exposing the applied material to UV energy. The method may include the above described additional optional method steps, and in particular the step of heating the workpiece after the applied material has been exposed to the UV energy.

The invention has been described with reference to the preferred embodiment.  
15 Modifications and alterations will occur to others upon a reading and understanding of this specification. It is intended to include all such modifications and alterations insofar as they come within the scope of the appended claims or the equivalents thereof.

CLAIMS

Having thus described the invention, we claim:

1. Method for applying material to a surface, comprising the steps of:  
preheating a surface;  
5 applying UV curable material to the preheated surface;  
exposing said applied material to ultraviolet (UV) energy.
2. The method of claim 1 wherein the step of preheating the surface comprises the step of induction heating the surface.
3. The method of claim 1 wherein the step of applying material to the surface  
10 comprises the step of spraying the material.
4. The method of claim 3 wherein said spraying step comprises an airless spraying process.
5. The method of claim 1 wherein the step of exposing said applied material to UV energy at least partially cures said material.
- 15 6. The method of claim 1 comprising a second step of heating the surface after exposing said material to UV energy.
7. The method of claim 6 wherein said second step of heating comprises induction heating.
8. The method of claim 1 comprising the step of causing relative spinning between  
20 the surface and a material application device during said step of applying material to the surface.
9. The method of claim 8 wherein the surface is spun at speeds greater than about 500 rpm.
10. The method of claim 8 wherein a material application device is spun at speeds greater than about 500 rpm
- 25 11. The method of claim 1 wherein the surface is heated to a temperature greater than about 150 °F.

12. A method for repairing a score line on a can lid, comprising the steps of:  
positioning a can lid having a score line for applying a UV curable material to a  
surface of the can lid;

applying said material to said surface to cover said score line; and

5 exposing said applied material to ultraviolet energy.

13. The method of claim 12 comprising the step of heating the can lid prior to  
applying said material thereto.

14. The method of claim 13 wherein said heating step comprises induction heating.

15 15. The method of claim 13 comprising the step of heating the can lid after exposing  
said applied material to UV energy.

16. The method of claim 12 comprising the step of heating the can lid after exposing  
said applied material to UV energy.

17. The method of claim 12 comprising the step of spinning the can lid during  
application of said material thereto.

18. The method of claim 12 comprising the step of producing a relative spinning  
motion between the can lid and a material application device during application of said material  
to the can lid.

19. The method of claim 12 wherein the step of applying said material to the can lid  
comprises spraying said material.

20 20. The method of claim 19 wherein said spraying is airless.

21. Apparatus for repairing a score line on a can lid by applying a coating material  
thereto, comprising:

a first device for holding a can lid in position for application of an ultraviolet (UV)  
curable material thereto;

25 a second device for spraying said UV curable material onto the can lid; and

a third device for exposing the can lid to UV energy.

22. The apparatus of claim 21 wherein said first device is a vacuum chuck.

23. The apparatus of claim 21 wherein said first device is a magnetic chuck.

24. The apparatus of claim 21 wherein said second device comprises a spray gun.

25. The apparatus of claim 24 wherein said spray gun is airless.

5 26. The apparatus of claim 21 comprising a fourth device for heating the can lid prior to application of said UV curable material thereto.

27. The apparatus of claim 26 wherein said fourth device comprises an induction heater.

10 28. The apparatus of claim 21 comprising a fifth device for heating the can lid after application of said UV curable material thereto.

30. The apparatus of claim 21 comprising a conveyor to position the can lid near said third device.

31. Apparatus for repairing a score line on a can lid by applying a coating material thereto, comprising:

15 a holder to position a can lid for application of an ultraviolet (UV) curable material thereto;

a first heater for heating the can lid and a second heater for heating the can lid;

a spray device for applying said UV curable material to the can lid; and

a UV source for exposing the can lid to UV energy;

20 wherein said first heater is positioned to heat the can lid prior to application of said UV curable material thereto and said second heater is positioned to heat the can lid after application of said UV curable material thereto.

32. The apparatus of claim 31 wherein said holder spins the can lid during application of said UV curable material thereto.

25 33. A method for repairing a score line on a can lid, comprising the steps of:

positioning a can lid having a score line for applying a UV curable material to a surface of the can lid;

heating the can lid prior to applying said UV curable material thereto;

spraying said material onto said surface to cover said score line;

5 exposing said applied material to ultraviolet energy; and

heating the can lid after applying said UV curable material thereto.

34. The method of claim 33 comprising the step of spinning the can lid during application of said UV curable material thereto.

35. Method for applying material to a surface, comprising the steps of:

10 preheating a metal surface using induction heating;

applying UV curable material to the preheated surface;

exposing said applied material to ultraviolet (UV) energy.

36. Method for applying material to a surface, comprising the steps of:

preheating a surface;

15 applying UV curable material to the preheated surface;

exposing said applied material to ultraviolet (UV) energy; and

heating the surface after exposing said applied material thereto.

37. Method for applying material to a surface, comprising the steps of:

preheating a metal surface using induction heating;

20 applying UV curable material to the preheated surface;

exposing said applied material to ultraviolet (UV) energy; and

heating the surface with induction heating after exposing said applied material thereto.

38. Method for applying material to a scored can lid, comprising the steps of:

25 applying UV curable material to the can lid surface; and curing the applied material by:

exposing said applied material to ultraviolet (UV) energy; and  
heating the surface after exposing said applied material thereto.

39. The method of claim 38 wherein said heating step is by induction heating.

40. The method of claim 39 further comprising the step of preheating the can lid  
5 surface by induction heating.

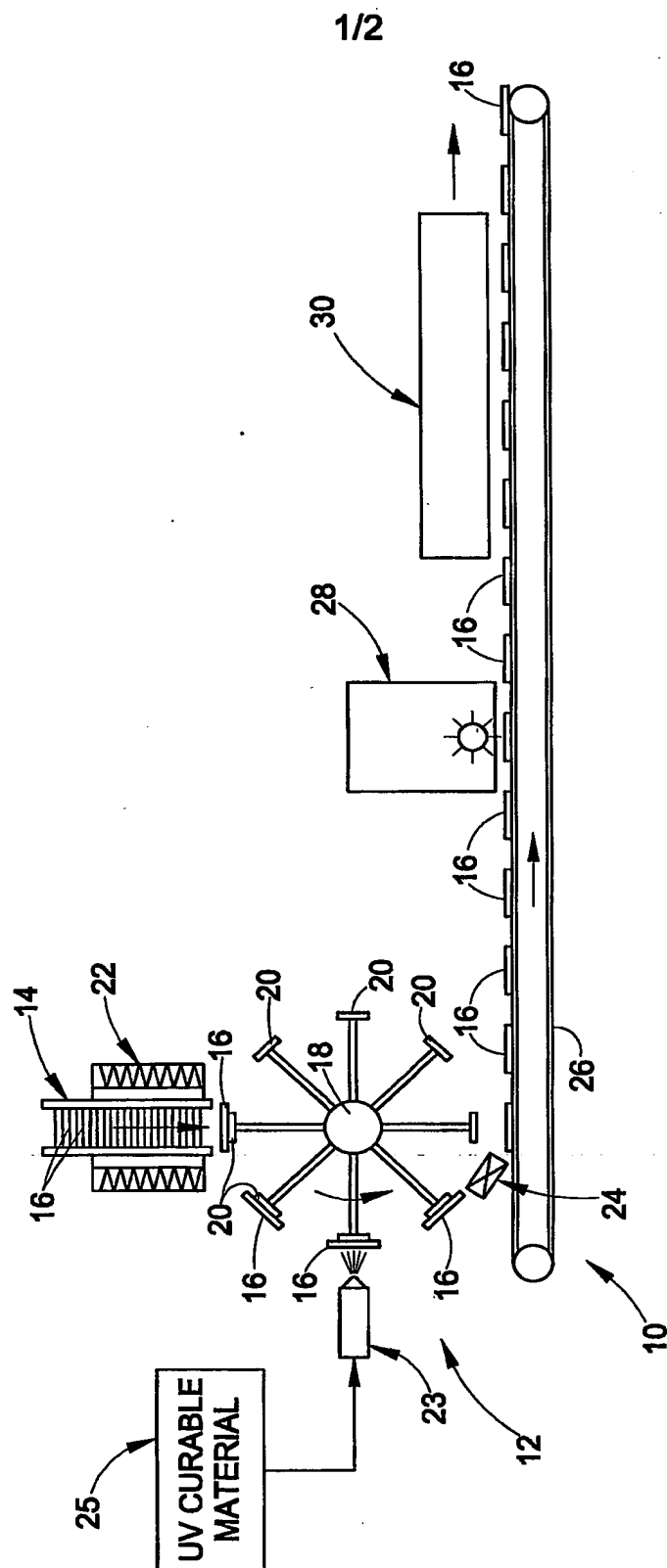
41. Apparatus for heating workpieces prior to a spraying operation, comprising:  
a stacker for holding a plurality of workpieces that can be received by a workpiece holder  
used during a spraying operation; and

a heater that surrounds a portion of said stacker so as to heat the workpieces as they pass  
10 therethrough.

42. The apparatus of claim 41 wherein said heater comprises an induction heater.

43. The apparatus of claim 41 wherein said workpieces are can lids.

44. The apparatus of claim 41 in combination with a spraying device that applies a  
UV curable material to each workpiece after the workpiece is preheated by said heater.



**FIG. 1**

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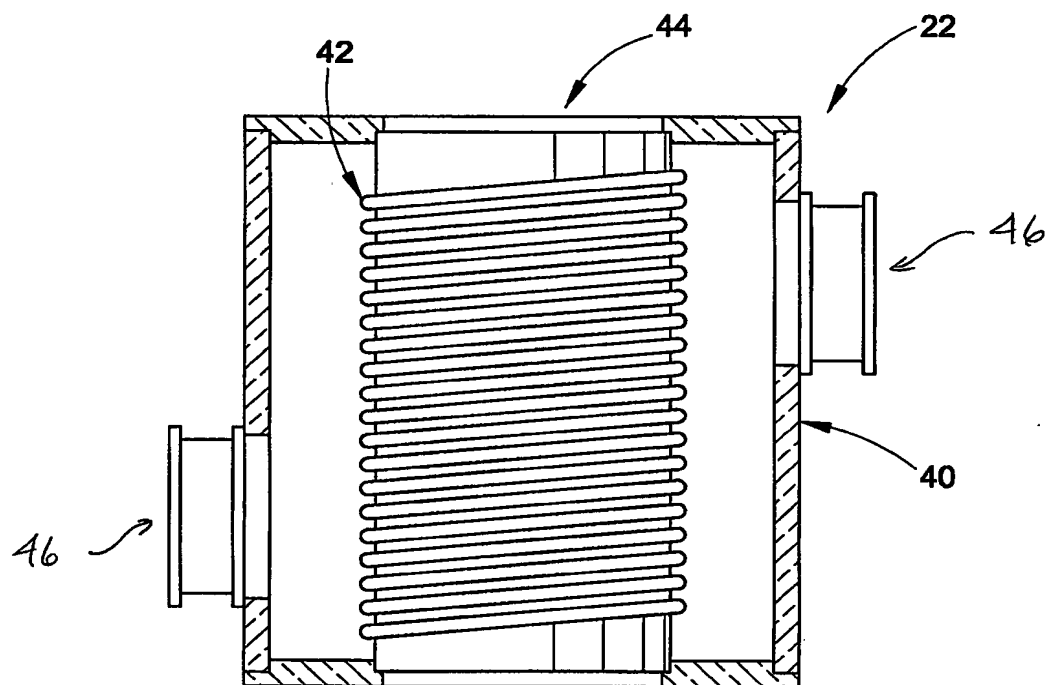


FIG. 2